



INTRODUCTION





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1.1

Introduction

India State of Forest Report (ISFR) is a biennial publication of Forest survey of India (FSI), an organization under the Ministry of Environment Forest, & Climate Change, Government of India, engaged in the assessment of the country's forest resources. The first State of Forest Report was brought out in 1987. Since then, FSI has published 14 such reports and the ISFR 2017 is the 15th in the series. The report provides state/district wise forest cover of the country and changes thereon with respect to the previous assessment. It also provides the estimates of growing stock within and outside the forest areas, forest cover in hill, tribal and north eastern states, carbon and other important aspects such as tree, bamboo and mangrove cover.

The forest cover assessment is a wall-to-wall mapping exercise based on remote sensing supported by intensive ground verification and field data from National Forest Inventory. The tree cover estimation is a sampling based exercise and estimated partly through high-resolution satellite data and partly through field inventory data of Trees Outside Forest (TOF). The information on growing/carbon stock and other important characteristics are estimated through field inventory data of forest and TOF under its regular inventory programme.

Technological Advancement in the assessment of forest cover

Over the years, several technological and methodological advances have taken place in the mapping of forest cover in terms of availability of better satellite data, higher scale maps and improved mode of interpretation. FSI has always kept pace with technological advancements and improved its assessment over the years.

The first remote sensing based nationwide forest cover assessment of 1987 was carried out using LANDSAT-MSS satellite data with a spatial resolution of 80 meters. The scale of mapping was 1:1,000,000 and mode of interpretation was visual with a Minimum Mappable Unit (MMU) of 400 ha. In 1989, LANDSAT-MSS satellite was replaced by LANDSAT-TM with a spatial resolution of 30 meters. The mapping was carried out at 1:250,000 scale thereby reducing the Minimum Mappable Unit (MMU) from 400 hectare to 25 hectare.

Since 1995, FSI started using indigenous remote sensing satellite data and mode of interpretation was partly shifted from visual to digital. The satellite data used for forest cover assessment since 2001 is LISS-III with a spatial resolution of 23.5 meters and a scale of interpretation of 1: 50,000. The mode of interpretation was shifted from visual to digital and the MMU has been further reduced from 25 ha to one ha.

The Table 1.1 shows a time line of technological advancement that took place in the assessment of forest cover over the last three decades.

Table 1.1 Forest Cover Mapping over the years

Cycle of Assess-ment	Year Period	Data	Sensor	Spatial Resolution	Scale	Minimum Mappable Unit (ha)	Mode of Interpretation
I	1987	1981-83	LANDSAT-MSS	80 m	1:1 million	400	Visual
II	1989	1985-87	LANDSAT-TM	30 m	1:250,000	25	Visual
III	1991	1987-89	LANDSAT-TM	30 m	1:250,000	25	Visual
IV	1993	1989-91	LANDSAT-TM	30 m	1:250,000	25	Visual
V	1995	1991-93	IRS-1B LISSII	36.25 m	1:250,000	25	Visual & Digital
VI	1997	1993-95	IRS-1B LISSII	36.25 m	1:250,000	25	Visual & Digital
VII	1999	1996-98	IRS-1C/1D LISS III	23.5 m	1:250,000	25	Visual & Digital
VIII	2001	2000	IRS-1C/1D LISS III	23.5 m	1:50,000	1	Digital
IX	2003	2002	IRS-1D LISS III	23.5 m	1:50,000	1	Digital
X	2005	2004	IRS-1D LISS III	23.5 m	1:50,000	1	Digital
XI	2009	2006	IRS-P6-LISS III	23.5 m	1:50,000	1	Digital
XII	2011	2008-09	IRS-P6-LISS III & IRS-P6 AWiFS	23.5 m 56 m	1:50,000	1	Digital
XIII	2013	2010-11	IRS P6-LISS-III IRS-Resourcesat-2 LISS III	23.5 m	1:50,000	1	Digital
XIV	2015	2013-14	IRS P6-LISS-III IRS-Resourcesat-2 LISS III	23.5 m	1:50,000	1	Digital
XV	2017	2015-16	IRS P6-LISS-III IRS-Resourcesat-2 LISS III	23.5 m	1:50,000	1	Digital



Due to the said technological and methodological advances, it was possible for FSI to classify forest cover into three density classes viz. Very Dense Forest (canopy density >70%), Moderately Dense Forest (canopy density 40 % to 70%) and Open Forest (canopy density 10 to 40%) since 2001, from the earlier two classes viz. Dense Forest (canopy density above 40%) and open forest (canopy density between 10% to 40%).

1.3

Forest Cover and Recorded Forest Area

The term 'Forest Cover' as used in ISFR refers to all lands more than one hectare in area with a tree canopy of more than 10 %, irrespective of land use, ownership and legal status. It may include even orchards, bamboo, palm etc and is assessed through remote sensing. On the other hand, the term 'Recorded Forest Area' or 'Forest Area' refers to all the geographic areas recorded as 'Forests' in government records. Recorded forest area mainly consists of Reserved Forests (RF) and Protected Forests (PF), which have been notified under the provisions of Indian Forest Act, 1927 or its counterpart State Acts. Besides RFs and PFs, the recorded forest area may also include all such areas, which have been recorded as forests in the revenue records or have been constituted so under any state Act or local laws.

Recorded forests may have blank areas with tree density less than 10 % such as degraded lands, wetlands, rivers, riverbeds, creeks in mangroves, snow-covered areas, glaciers and other snow covered areas, alpine pastures, cold deserts, grasslands etc. As per the definition of forest cover, such areas are excluded from the assessment of forest cover. On the other hand, there are areas outside the recorded forests with tree patches of one hectare and more with canopy density above 10%. For example plantations on the private/ community lands, road, rail and canal sides, rubber, tea, and coffee plantations etc. Such areas also constitute forest cover and are included in the forest cover assessment. The Recorded Forest area (RFA) as reported by the State/UT forest departments are given in Table 1.2 for reference.

Table 1.2: Recorded Forest Areas (RFAs) in States and UTs

State/ UT	Geographical Area	Area (GA) reported in ISFR 2015	RFA (as revised by SFDs)			Total RFA (2017)	per-cent of GA
			RF	PF	Unclassed Forests		
Andhra Pradesh	162,968	37,258	31,959	5,069	230	37,258	22.86
Arunachal Pradesh	83,743	51,407	10,589	9,779	31,039	51,407	61.39
Assam	78,438	26,832	17,864	0	8,968	26,832	34.21
Bihar	94,163	6,493	693	6,183	1	6,877	7.30
Chhattisgarh	135,192	59,772	25,782	24,036	9,954	59,772	44.21
Delhi	1,483	102	78	24	0	102	6.88
Goa	3,702	1,225	253	0	972	1,225	33.09
Gujarat	196,244	21,647	14,373	2,886	4,388	21,647	11.03
Haryana	44,212	1,559	249	1,158	152	1,559	3.53
Himachal Pradesh	55,673	37,033	1,898	33,130	2,005	37,033	66.52
Jammu & Kashmir [#]	222,236	20,230	17,643	2,551	36	20,230	9.10
Jharkhand	79,716	23,605	4,387	19,185	33	23,605	29.61
Karnataka	191,791	38,284	28,690	3,931	5,663	38,284	19.96
Kerala	38,852	11,309	11,309	0	0	11,309	29.11
Madhya Pradesh	308,252	94,689	61,886	31,098	1,705	94,689	30.72
Maharashtra	307,713	61,579	49,546	6,733	5,300	61,579	20.01
Manipur	22,327	17,418	1,467	4,171	11,780	17,418	78.01
Meghalaya	22,429	9,496	1,113	12	8,371	9,496	42.34
Mizoram	21,081	5,641	4,483	0	1,158	5,641	26.76
Nagaland	16,579	9,222	234	0	8,389	8,623	52.01
Odisha*	155,707	58,136	36,049	25,133	22	61,204	39.31
Punjab	50,362	3,084	44	1,137	1,903	3,084	6.12
Rajasthan	342,239	32,737	12,475	18,217	2,045	32,737	9.57
Sikkim	7,096	5,841	5,452	389	0	5,841	82.31
Tamil Nadu	130,060	22,877	20,293	1,782	802	22,877	17.59
Telangana	112,077	26,904	20,353	5,939	612	26,904	24.00
Tripura	10,486	6,294	4,175	2	2,117	6,294	60.02
Uttar Pradesh	240,928	16,582	12,071	1,157	3,354	16,582	6.88
Uttarakhand	53,483	38,000	26,547	9,885	1,568	38,000	71.05
West Bengal	88,752	11,879	7,054	3,772	1,053	11,879	13.38
A & N Islands	8,249	7,171	5,613	1,558	0	7,171	86.93
Chandigarh	114	35	32	0	3	35	30.70
Dadra & Nagar Haveli	491	204	199	5	0	204	41.55
Daman & Diu	111	8	0	0	8	8	7.21
Lakshadweep	30	0	0	0	0	0	0.00
Puducherry	490	13	0	2	11	13	2.65
Total	32,87,469	7,64,566	4,34,705	2,19,432	1,13,881	7,67,419	23.34

Source: State Forest Departments

Includes Jammu & Kashmir area outside LoC that is under illegal occupation of Pakistan and China.

* RF in Odisha includes 9,175 sq km of proposed RF, PF includes 15,117 sq km revenue forest/deemed forest and 191 sq km private forest.

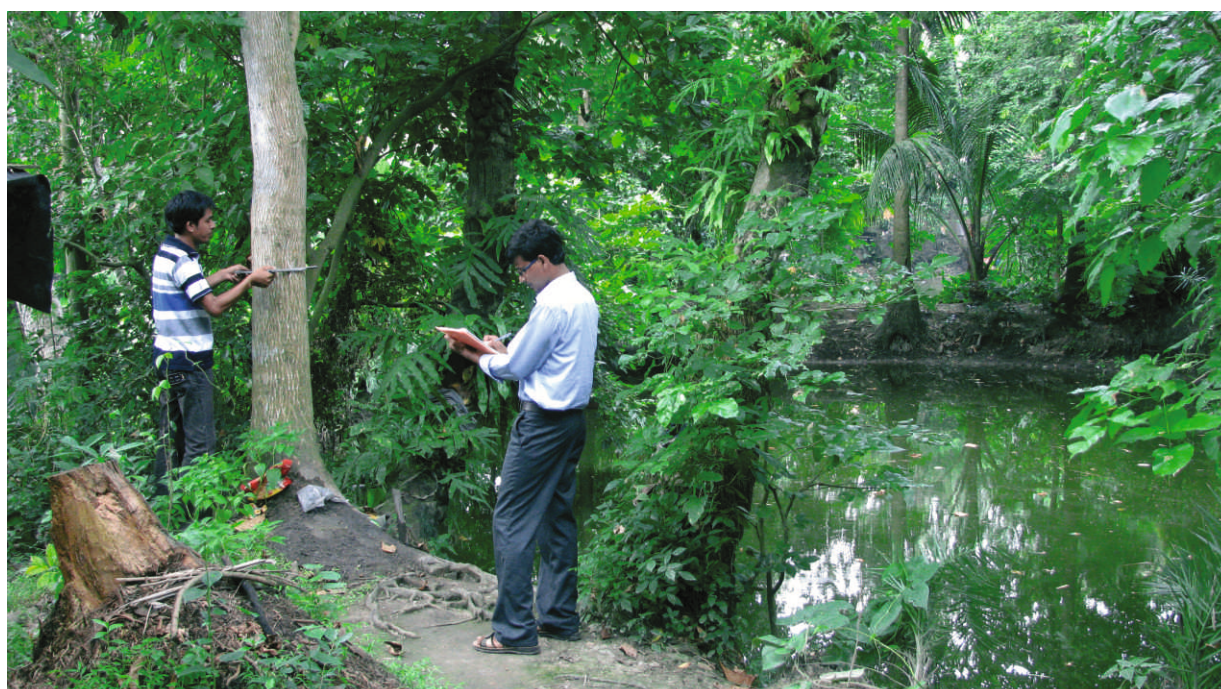
National Forest Inventory (NFI)

Growing Stock or the standing volume of wood is an important parameter needed to determine the reference level of the forest, carbon stock and calculation of biomass, all of which are assessed through the National Forestry Inventory exercise which is an important periodical activity of FSI. The National Forest Inventory was designed and executed since 2002 and the first nation level estimates of Growing Stock for forests and TOF were published in the State of Forest Report 2003.

The methodology involves stratifying the country into 14 physiographic zones based on broad similarities in climatic and physiographic factors such as altitude, geographic location, soil and soil moisture content, precipitation, temperature etc. The 14 zones are Western Himalayas, Eastern Himalayas, North East, Northern Plains, Eastern Plains, Western Plains, Central Highlands, North Deccan, East Deccan, Western Ghats, Eastern Ghats, East and West Coasts. NFI is a sample based exercise under which selected sample districts are inventoried in a two-year cycle both for forest and TOF.

Two stage stratified sampling design has been used for inventory of forest and TOF. 60 districts are selected randomly from the entire country with around 7000 sample plots inside forest and 10,000 sample plots are laid out in TOF for the detailed inventory at a cycle of two years. The data collected from field is captured into a unified database and stored at FSI Headquarters using a data entry module developed by FSI. Diameter wise estimated stems and their volume according to species are given in ISFR. Estimation of growing stock at state level is also carried out and given in ISFR. Further details of the methodology have been given in chapter 5 of this report dealing with growing stock. The four zonal offices of FSI execute the field work.

FSI also estimates the annual potential production of timber from outside forest areas on the basis of TOF inventory data. This information is supplied to Central Statistics Office (CSO) for calculation of GDP for the forestry sector. State wise production of timber from TOF has been given in chapter 5. Growing stock has assumed a significant importance in the recent past as it forms the basis for calculation of carbon stock and forest reference level. The carbon stock information has also been used for deciding the target for India's Intended Nationally Determined Contributions (INDC).





In the current report, besides the chapters on Tree cover and Growing stock two additional chapters on Carbon Stock in India's Forests and Bamboo Resources of India have been incorporated. The chapters on Tree cover, Growing stock, Carbon Stock in India's Forests and Bamboo Resources are based on the field inventory of forests and TOF. These chapters give information about tree cover, species and diameter wise growing stock, carbon stock estimates at national and state level and bamboo bearing area & growing stock in bamboo at national and state level.

1.5

Special Features in ISFR 2017

1.5.1

Assessment of Forest Cover within Recorded Forest Area (RFA) of 16 States

The forest cover of the country is assessed irrespective of ownership, legal status and land use. This information provides qualitative and quantitative attributes for better and effective forest management and for devising appropriate conservation strategies. The major portion of the forest cover, however, falls within the recorded forests. The assessment of area of the forest cover within the recorded forests is subject to availability of digitized boundaries of the RFA from the SFDs.

Till date, digitized forest boundaries of RFA from only 16 States are available and accordingly have been used for analysis and calculation of Forest Cover in the present ISFR. These States/UTs are Andhra Pradesh, Chhattisgarh, Gujarat, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Rajasthan, Tamil Nadu, Telangana, Uttarakhand, Andaman & Nicobar Islands, Goa, West Bengal, Maharashtra and Odisha.

1.5.2

Assessment of forest cover within and outside Green-wash area for the states where RFA boundary is not available

Due to non-availability of digitized boundaries of RFA from many states, it is not possible to give forest cover inside and outside the recorded forest area of such states. Thus, in the absence of digitized boundaries of the RFA, green wash areas have been taken as proxy to RFA. The green-wash refer to the portions of Survey of India topographic sheets representing the forest at the time of survey carried out to prepare such topographic sheets. This green wash by and large corresponds to recorded forest area of the country. In this report, FSI has given information on forest cover in and outside green wash area for those states from where the digitized boundary of RFA is not available.

1.5.3

Information of forest cover in 633 districts in place of 589 districts

As per Census 2001, there were 593 districts, out of which FSI reported forest cover information for 589 districts in the previous ISFRs till 2015. However, in the present report, the information has been given for 633 districts by using new and updated district boundaries and Open Series Maps from Survey of India. The geographical area of these districts has been taken from Census, 2011. Further, Census 2011 also indicates an increase of 206 sq km in the total geographical area of the country. The details of new districts being reported during the current cycle, in various State/UTs is depicted in Table 1.3:

Table 1.3 State/UT wise details of newly added districts				
S.No.	Name of States	No of Districts as per ISFR 2015	No. of Districts as per ISFR 2017 (Source: Census 2011)	Difference
1	Arunachal Pradesh	13	16	3
2	Assam	23	27	4
3	Bihar	37	38	1
4	Chhattisgarh	16	18	2
5	Gujarat	25	26	1
6	Haryana	19	21	2
7	Jharkhand	18	24	6
8	Karnataka	27	30	3
9	Madhya Pradesh	45	50	5
10	Nagaland	8	11	3
11	Punjab	17	20	3
12	Rajasthan	29	33	4
13	Tamil Nadu	30	32	2
14	Uttar Pradesh	68	71	3
15	West Bengal	18	19	1
16	Andaman & Nicobar Islands	2	3	1
Total		395	439	44

1.5.4

Estimation of carbon stock in India's forest

Forest Survey of India has been periodically estimating forest biomass and carbon stock change. Estimate of carbon in woody growing stock by FSI was reflected in India's Initial National Communication (INC) submitted to United Nation Framework Convention on Climate Change (UNFCCC) in 2004. In 2010, FSI has completed estimation of forest carbon stock and change between two time period viz. 1994 and 2004 as part of Second National Communication (SNC) to UNFCCC.

FSI follows the methodology of 'Good Practices Guidance' (GPG) developed by Inter-governmental panel on Climate Change (IPCC). For estimation of emission factors for different strata, data of National Forest Inventory (NFI) has been used. Biomass equations/factors were developed through a special study conducted by FSI. GIS techniques were used for synthesizing the data and to estimate carbon stock under different carbon pools. Considering its importance, a separate chapter has been given in the present report containing state wise information on carbon stock in the country's forests.

1.5.5

Forest Fire monitoring

Forest fires are a recurrent phenomenon in India during fire season which is generally from January to June. FSI has been carrying out real time forest fire monitoring at national level since 2004 using Remote Sensing and GIS technology with the objective to detect and inform State Forest Departments about active forest fires on near real time basis. From the year 2012, the time duration between satellite pass and the time of dissemination of forest fire alerts by FSI has been reduced to nearly 2 hours, thus bringing the mechanism of signal reception, processing and dissemination on to a near real time mode. This has considerably minimized the reaction time towards remedial and preventive measures on ground by the state forest departments. A statement showing the fire alerts issued by FSI to the SFDs during the last five years is given in Table 1.4.



In order to advise the State Forest Departments on vulnerable areas, which are prone to forest fires in the near future, a pre-warning alert system for forest fires has been developed and made operational from the year 2016. The pre- warning fire alerts valid for the ensuing week are generated based on certain parameters such as Forest Cover, Forest Type, Climatic Variables (Temperature, Relative Humidity and Rainfall) and past fire incidences over the area etc. The forest areas found vulnerable are communicated to the Nodal Officers of State Forest Departments, as pre-warning forest fire alerts in the form of KML files through email. This system is currently under updation to include a more robust grid based pre warning system by including additional parameters such as transport networks, habitations, humidity, wind speed, weather forecast, etc

Table 1.4 State/UT wise details of MODIS Forest Fire Alerts disseminated during 2013- 2017

S. No.	State	2013	2014	2015	2016	2017
1.	Andhra Pradesh [§]	2,143	2,458	1,075	1,699	1,877
2.	Arunachal Pradesh	501	535	358	293	733
3.	Assam	1,608	2,536	1,656	1,766	1,887
4.	Bihar	273	140	45	321	272
5.	Chhattisgarh	1,530	1,018	1,272	2,808	4,373
6.	Delhi	0	0	0	2	5
7.	Goa	4	3	0	10	32
8.	Gujarat	179	74	117	262	574
9.	Haryana	5	5	6	43	185
10.	Himachal Pradesh	34	32	22	199	170
11.	Jammu & Kashmir	23	74	13	217	113
12.	Jharkhand	554	202	457	740	1,133
13.	Karnataka	606	424	295	831	1,333
14.	Kerala	98	114	91	165	456
15.	Madhya Pradesh	753	534	294	2,675	4,781
16.	Maharashtra	1,433	702	721	1,874	3,487
17.	Manipur	1,303	1,774	1,286	1,105	1,094
18.	Meghalaya	804	1,123	1,373	966	1,454
19.	Mizoram	2,259	2,189	2,468	1,318	1,587
20.	Nagaland	846	886	722	678	930
21.	Odisha	2,221	1,904	1,467	2,763	4,416
22.	Punjab	36	20	7	45	320
23.	Rajasthan	75	53	90	66	260
24.	Sikkim	0	0	3	0	8
25.	Tamil Nadu	89	284	95	113	301
26.	Telangana	Not Applicable	Not Applicable	1,052	1,154	1,748
27.	Tripura	588	1,160	476	346	431
28.	Uttar Pradesh	237	218	130	691	1,170
29.	Uttarakhand	119	379	207	1,501	376
30.	West Bengal	118	116	138	142	364
31.	Andaman & Nicobar Islands	9	96	1	24	8
32.	Chandigarh	0	0	0	0	1
33.	Dadra & Nagar Haveli	3	1	0	0	0
34.	Daman & Diu	0	0	0	0	0
35.	Lakshadweep	0	0	0	0	0
36.	Puducherry	0	0	0	0	9
	Total	18,451	19,054	15,937	24,817	35,888

§ The alerts for the years 2013 and 2014 pertain to the undivided State of Andhra Pradesh

1.5.6

Decadal change in water bodies

Keeping in view the role of forests in maintaining hydrological balance and river flows, an effort has been made to assess the status of water bodies in the forests over a period of ten years (2005–2015). For the purpose, all the water bodies which are situated inside forested areas or upto a kilometer from its boundary have been considered. The details of the decadal change of 2647 sq km has been reflected State wise under Chapter 9.

1.6

Recent Initiatives of FSI

1.6.1

e-Green Watch

Plantations and other assets are created by state forest departments under CAMPA. Systematic monitoring and evaluation of these activities including plantations is a pre requisite for the financial accountability and success on ground.

The e-Green Watch is a web-based user-friendly application developed by NIC that is transparent, reliable and accountable. It enables the temporal change detection for the effective monitoring and evaluation. The application hosted on FSI portal is capable of depicting the Compensatory Afforestation, Diverted Land, Plantations, and other Asset categories on the Google earth imagery.

At present 28 States and UTs are linked to the e-Green Watch Portal. Under this programme, the SFDs upload polygons (shape files) corresponding to field activities under above-mentioned categories. FSI monitors these polygons online and a monthly report is submitted to the MoEF&CC. Till June 2016, FSI has verified 86,036 Polygons uploaded by the state forest departments and has also revisited 35,375 polygons.

1.6.2

Decision Support System (DSS)

Decision Support System (DSS) is Web-GIS based application developed by FSI, to provide qualitative and quantitative information with respect to Forests. Launched in November, 2014, the DSS enables forest managers to arrive at a well informed decision. This system is highly useful for taking decisions with respect to proposals under Forest Conservation Act, 1980.

Geospatial Data used in the DSS application includes Hydrological layer, Protected Areas (PA) including Tiger Reserves (TR), Tiger corridors, Forest Cover layer, Forest Types layer, Biological Richness (BR), and Landscape Integrity (LI) etc. This portal expedites the process of decision making and calculation of Net Present Value. Other layers like State, District and Forest Administrative boundaries, Recorded Forest Area are also available for visualization. User Id and password to access and use the application has been provided to nearly 1000 users comprising of Officers of the State Forest Departments upto the level of DCF and also to the Ministry and its Regional Offices. With the inclusion of layers pertaining to Eco-sensitive Zone, Coastal Regulation Zone and Mining areas in near future, this system would be more useful.

1.6.3

New Sampling design for NFI

As per the existing sampling design for NFI operational since 2002, about 60 districts spread over the entire country were selected for detailed inventory of forest and TOF in a cycle of two years. Based on the data collected from these 60 districts, physiographic zone and national level estimates of growing stock were generated at an acceptable precision level. Considering 600 districts in the country, the revisit time under this design was 20 year. However, as per the national and international requirements, it was felt that the revisit time should be reduced from existing 20 years to 5 years and the state level estimates should be generated at a higher and acceptable precision. Considering these facts and studying the NFI design of many developed countries, FSI has modified its new NFI design and implemented it since February 2016.

The new sampling design is a grid based instead of district based as used to be earlier. Under the new design, nationwide grids of 5 km x 5 km have been created. Each year, selected grids are selected for forest and TOF inventory. The cycle for forest inventory is kept at 5 years and cycle for TOF has been kept at 10 years. The new design fully integrates Remote Sensing and GIS. About 7000 sample plots in forest areas and 10,000 sample plots in TOF will be laid out every year under the new design. The main advantages of new design would be to reduce the revisit time of forest inventory from 20 years to 5 years and to generate state level estimates with better and acceptable precision. Many new parameters such as NTFP, invasive species, availability of water (near sample plot) etc. has been added in the new NFI design. The results of the new NFI will be published in ISFR 2019.

1.6.4

Designing NFI for Sri Lanka with collaboration with FAO

As part of South-South Cooperation, FSI signed a Letter of Agreement (LoA) with FAO, Sri Lanka for designing and developing a National Forest Inventory (NFI) system for Sri Lanka Forest Department. Under this project, FSI prepared a sampling design, field manual and forms, data entry and processing modules etc necessary for carrying out forest inventory. In Sri Lanka, FSI designed the field forms, prepared the field manual and empowered the field functionaries through a series of trainings conducted at Dehradun as well as in Sri Lanka. Training programmes were also conducted on data entry, checking and processing.

The project started in April, 2016 and completed in June 2017. The project outcomes in the form of a 'Manual for NFI Sri Lanka' and 'Methodology document' have been handed over to Sri Lankan Forest Department & FAO, Sri Lanka in June 2017. This assignment was highly appreciated by the FAO and Sri Lanka Forest Department.

The Sri Lanka Forest Department has shown their interest for further collaboration with FSI in the field of assessment of Trees Outside Forest, development of volume equations for important timber species of Sri Lanka and laying out of permanent observations plots.

1.6.5

Technical Cooperation Programme for National Forest Monitoring System (NFMS)

FSI has initiated a Technical Cooperation Programme (TCP) for Strengthening National Forest Inventory and Monitoring Protocols and Capacities in India with the technical assistance of FAO. The main objectives of the project are to develop and set up a new integrated National Forest Monitoring System

(NFMS), build national capacities on forest monitoring and pilot test implementation in selected states. It also includes linkage of NFMS with working plan, integration of RS/GIS with inventory and laying out permanent sample plots etc. Six pilot states have been selected across the country as per the framework of the TCP and a number of workshops have been conducted at different places in the country so far.

Various objectives envisaged under the project namely, information need analysis, forest observational studies and integration of remote sensing and field inventory data are being carried out through engagement of international/national consultants by FAO in consultation with FSI. At the end of the project a final report will be synthesized by FAO in consultation with FSI which will give recommendations for developing a robust National Forest Monitoring System for the country.

1.6.6

Use of VHR data in forest monitoring

Technological advances and increasing availability of very high-resolution satellite imagery offer the potential for more accurate land cover classifications and pattern analysis, which could greatly improve the detection and quantification of land cover change for conservation. Very High Resolution (VHR) satellite imageries have sub meter spatial resolution. High spatial resolution and accurate ortho-rectification ensures precise positional accuracy and generates more detail of the ground captured. Thus VHR data can be a key source of information for many forest related studies such as monitoring of plantations, mining, encroachment, estimation of carbon and growing stock in forests etc.

To begin with, FSI has established a VHR lab with required hardware and Software. Training and Capacity building work for FSI officials engaged in this work has been carried out. Currently, FSI has procured the VHR data of two states viz: Karnataka and Maharashtra as these states cover a large area of Western Ghats which is one of the 8 Biodiversity Hotspots of the world hosting non-equatorial tropical evergreen forests with exceptional levels of plant endemism.

Applications of Very High Resolution Data

- Plantation Monitoring
- Asset monitoring
- Better visualization
- Better estimates for Inventory
- Improvement of Forest Type Mapping
- Forest Fire Burnt Area Assessment
- Monitoring of diverted forest lands (mining areas).
- Use in Environmental Impact Assessment (EIA).



Global changes in forest area

FAO regularly monitors the world's forests and their management under Global Forest Resources Assessments (GFRA) through country reporting system by member countries. Every five years, FAO brings out a report on GFRA, which provides trend of global forest resources and changes as compared to previous assessment. The latest report published by FAO is GFRA 2015. It examines the current status and recent trends for about 90 variables covering the extent, condition, uses etc of forests and other wooded land, with the aim of assessing all benefits from forest resources.

As per the GFRA 2015, it is observed that over the past 25 years forest area has reduced from 4.1 billion ha to 4 billion ha, a decrease of 3.1 percent. The rate of global forest area change has slowed by more than 50 percent between 1990 and 2015. This change results from a combination of reduced forest conversion rates in some countries and increased forest area expansion in others.

The forest area for top ten countries in 2015 is given in Table 1.5. These countries account for some 67 percent of global forest area. India is placed as 10th in the top ten countries.

Table 1.5 Forest area for top ten countries in 2015

S. No.	Country	Forest area (000 ha)	% of country area	% global forest area
1	Russian Federation	814931	48	20
2	Brazil	493538	58	12
3	Canada	347069	35	9
4	Unites State of America	310095	32	8
5	China	208321	22	5
6	Democratic Republic of the Congo	152578	65	4
7	Australia	124751	16	3
8	Indonesia	91010	50	2
9	Peru	73973	58	2
10	India	70682	22	2
Total		26869	48	67

As per GFRA 2015, top ten countries reporting greatest annual forest area gain is given in Table 1.6.

Table 1.6: Countries reporting the greatest annual forest area gain (2010-15)

S. No.	Country	Annual Forest area gain	
		Area (000 ha)	% of 2010 forest area
1	China	1542	0.8
2	Australia	308	0.2
3	Chile	301	1.9
4	United State of America	275	0.1
5	Philippines	240	3.5
6	Gabon	200	0.9
7	Lao People's Democratic Republic	189	1.1
8	India	178	0.3
9	Viet Nam	129	0.9
10	France	113	0.7